

**Energy Water Nexus  
Western Workshop  
Group A**

**Day 1 – Session 1 -  
Problem Areas - Energy Supply**

Dean Richards – Richard Labs  
Mary Johannis - BPA  
Dan Seligman - Columbia Research Corp.  
Eliza Jane Whitman - Inland Empire Util. Agency  
Jaralyn Beek - Reclamation  
Gary Woodward – Univ. of Arizona  
Al Dietemann – City of Seattle  
Sherri Thomas – Utton Center  
John Kounts – WA Pub Utilities  
Larry Morandi – Nat. Conf. of State Legislatures  
John McCray – Colorado School of Mines  
Kenya Crosson – BNL  
Jean Lee – SNL  
Del Garner - BYU  
Tom Acker - NAU

Ernie Avila – Northern CA Salinity Coalition  
Harvey Boyce – AZ Power Utility  
Ronnie Cohen – Natural Res. Defense Council  
Wayne Dyok – MWH Sacramento, Hydro power  
Paul Jehn – GWPC  
Nykole Littleboy – UT Energy Program  
Philip Murphree – Powder River Coal Co.  
David Stewart – Stewart Environ. Consultants  
Reagan Waskom – CO WRRRI  
Lois Wright – Sacramento Mun. Utility District  
Ed Baruth - AWWA  
Mike Sale - ORNL  
Mike Hightower - SNL  
John Boysen – AZ Poer Authority  
George Diwachak - BLM

**Problem Areas Water for Energy Supply**

**Term, Trend, Cert.**

**Extraction**

**Oil and gas**

- Oil and gas produced water permit issues over use and selling treated produced water plus permits for injection wells, can take 5 years, require several different state and federal agencies for permits – states not geared up with water rights for deep water
  - Quality issues of produced water
  - Want no surface discharge of produced water
  - NPDES permits hard to come by too
- Long-term impacts of produced water discharge to BOR reservoirs
  - Saline lenses, groundwater to surface water
  - Policy issues over state water law and federal
  - Need study of surface discharge of produced water impacts on fish, Downstream users, damage to reservoirs, transient nature of produced water outflows
- Produced water quality will drive - options for oil and gas production
  - soil water interactions are still not well understood
  - SAR impacts of produced water on soil discharge are not well understood
- Use of produced water for frac-ing, stimulations, etc.
  - Some examples exist that show this can be done, but not widely used
  - Little efforts to do technology transfer of this

- Need to look at CBM, oil sands, and oil shale issues on water quantity and water quality
  - EIS studies underway – is emerging
    - Need to look at newer technology options,
    - In situ gasification is possible for direct power use
- Issue of Tributary, non-tributary, and ground water institutional situation issues
  - Regulations and permits different for each
  - Need better modeling to determine interactions
  - CBM produced water withdrawal appears to be impacting aquifer drawdown, therefore need better modeling
- Need to open up offshore oil and gas

#### Coal Mining

- Dust suppression is a big issue – need water and would like to recycle plant water
- Removal of coal fines from plant water so can recycle water for dust suppression
- See water availability for expansion of coal mines becoming a problem
- Dust suppression major concern

#### **Fuel Production and Refining**

- Water availability for coal gasification and liquid coal enhancement and issue
- Lack of sustainable water source for refining
  - If use reclaimed water they want a reliable supply and backup supply
  - Water quality issues, who pays for it
  - If can reduce cost of water treatment, many supplies become available, i.e. brackish water
- Biodiesel and wood to ethanol
  - Economics may limit availability
  - Water will also limit opportunities
    - Cellulose ethanol uses less water and should be developed
  - With crop subsidies, some direction toward use of water for sugar can in southwest
  - No good information on energy water impacts – need system level evaluation along with subsidy issues
  - Policy issues on air quality driving ethanol use – have their own constituency that may want to increase ethanol regardless of water use
  - Ethanol production currently by coops – have their own constituency
- Biomass plants
  - Can improve water quality and water availability in areas by improved watershed management
- Pipelines are limited to oil and gas to other areas

## **Electricity Production**

### Hydro

- Tradeoff of fish, barges, electricity generation limiting water availability for power
  - Potential consequences are loss of peaking capability for CA
  - Could reduce NW power – constrains operations
    - Limits peaking again and use of things like wind
  - Need more monitoring to evaluate information
- Policies for irrigation are limiting higher value use of water for hydro
- Have no techniques to assess the highest social value of water
  - System evaluation – take into consideration air quality, water quality, cost effectiveness,
  - Current data can be misinterpreted
  - Institutional issues currently limit broad systems analysis
  - Many agencies involved and many points of view, but should be coordinated
- Hydro laws based on 100 year old technology and issues
  - Includes concerns on subsidies, technology basis
  - Needs to be totally revisited

### Thermoelectric

- In using reclaimed water for cooling, plants still want backup fresh water
- Co-location of power and water plants for efficiency are causing permitting issues
  - Open up permitting of power plant for new intake screening requirements
  - Need to buttress federal process to minimize the risk of this happening so can increase efficiency
  - Need to promote new technology to help reduce risks on use and provide info on impingement, limits on intake efficiency, etc. will accelerate conversion
- Desalination as backup allows power backup and allows fresh water backup
  - Issues, brine discharge,
- Will use lots of groundwater
  - Little understanding of groundwater availability
  - Deep aquifers not well understood
  - Gap in getting data on gw data from private hands into public use
    - Need regs on how much of data to make available – use tax incentives
- Future Gen
  - Need demonstration and build it
  - Need to assess the water impacts now
  - Look at water quality impacts and aquifer characteristics and

### Transmission Capacity Issues

- No transmission in areas with water or with places with energy
- Environmental and financing issues for funding of large projects and power lands

- FERC does not understand the difference in east and west areas
  - West is large distances between cities – few connections
- Need to be able to better understand reliability issues because of nature of west system

#### Water rights

- West has not adjudicated all water rights – do not know what we have
  - Needs to be developed now
  - Issues over prior rights and use of reclaimed water
- States water rights have major differences
  - Need to have a federal role
  - Need to have cooperation on developing water use and information

### **Renewable Sources**

#### Biofuels

- Removal of solids from water would allow recycling

#### Wind

- Lack of understanding of grid integration issues for intermittent technologies
- Need to identify and understand threshold of intermittent sources
- May be able to support pumped storage with water since water easier to store and then use water as hydro power during peak times
- Transmission limits application of wind
- Ecological impact of wind

#### Water flooding

- Spray water on roofs to reduce home cooling energy needs

#### Geothermal cooling water

- Improvement of heat exchanger performance for brackish waters
  - Would have wide application

#### Solar

- More research needed to drive costs down

#### Algae

- Need to get better understanding of CO<sub>2</sub> sequestration and water use with algae as an energy source

#### Outreach

- Need more information on renewables on water use and other data so people can determine what they want and make good decisions
  - Needs to provide this in terms of water use, CO<sub>2</sub> abatement, air pollution, costs, etc. in a systems level approach

### **Other**

- In west, use it or lose it, is forcing bad use of water
- Need research to identify where and how to use the concentrate
- Hydrogen economy based on water is an issue that needs to be addressed

### **Ranking**

**Energy Water Nexus  
West Workshop  
Group A**

**Day 1 – Session 2 -  
Problem Areas - Water Supply Impacts**

Dean Richards – Richard Labs	Ernie Avila – Northern CA Salinity Coalition
Mary Johannis - BPA	Harvey Boyce – AZ Power Utility
Dan Seligman - Cloumbia Research Corp.	Ronnie Cohen – Natural Resource Defense Council
Eliza Jane Whitman - Inland Empire Utility Agency	Wayne Dyok – MWH
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**Urban Use**

**Term, Trend, Cert.**

**Domestic**

- Not all use consumptive – but in some communities all water may be lost even if not consumed
- Water quality
  - Source control
  - Protection of watershed
  - Need to reduce energy requirements to meet emerging water quality standards
- Not all water needs to be potable so could save energy
- Consider best location for water recharge – would save energy to pump water
- No national water efficiency program – No equivalent energy star program
  - DOE needs to develop water efficiency program and put more science on it
  - Coordinate with EPA and water associations
- Both water and energy demand outstripping growth
  - Fewer people per household – more houses
  - People living inland – needs more energy and water – hotter in summer and colder in winter
- Need water and energy standards for homes
- Look at new technologies for water use in domestic applications

**Coordination of Water and Energy Efficiency Use**

- Many agencies have programs of different scope in this. This needs to be better coordinated.

Integration of energy and water concepts in water systems

- Need to understand that domestic water systems, based on fire protection, should be reassessed.
- Other types of designs could save energy and water

Flood Control

- Limits water storage in reservoirs that limits water savings

Water Conservation

- Never consider energy impacts of water conservation

Industrial ecology

- Lots of opportunities for CHP, use of waste heat

Need for in-stream flows impact water availability for other sectors

### Ag Use

Withdrawal of water is an issue

- Efficiency in water use and water consumption are both important
- Return flows are generally contaminated and are a problem for downstream users – need more energy for treatment

Beneficial use laws are problematic

- Causes loss of water – use it or lose it
- Reallocation of water for conservation is a problem
  - Conservation incentives need to be able to define the amount of water conserved
  - Must be able to meet return flow needs for downstream users

Ag runoff impacts ground water quality

- Requires treatment of gw and energy needs for use

In-stream flows are a competing demand for ag use

Livestock uses

- Can provide energy to treat water and make energy
- Need to address water contamination from feedlots
  - Technology exists to treat water but some are exempt from treatment
  - Need to see how wastewater treatment plants could support this treatment

## **Energy Production and Generation Impacts on water**

- Entrainment of fish issues in once through systems
  - Also an issue for hydro plants
  - Also an issue for LNG imports
- Thermal impacts of cooling on water ecology
- Inconsistent ability to use reclaimed water
- Change in use of hydro from peaking uses to base load uses
- New fossil energy generation in low water availability areas

Pricing structure of energy to include externalities – including water efficiency, environmental issues

- Similar to water pricing – need to make sure energy prices match real energy costs

Lack of incentives for collocation of energy and water facilities to increase efficiencies

## **Recreation & Societal Use**

Use of reservoirs is important part of re-licensing

Recreation impacts water quality

- Bring in zebra mussels
- People impact water quality
- Water treatment impact and forces more energy use – aeration of water, treatment of degraded water

Tradeoff of loss vs. gain of recreational opportunities with hydro reservoirs

## **Environmental Management**

- In-stream flows are competing against other uses and will limit water availability
- Lose energy generation to minimize salt water intrusion in coastal areas
- Biological Opinions driving release of water that then can not be stored for hydro operations
- Contamination of water from nuclear power plants
- Thermal plumes from power plants impact ecology
- Biomass use for energy can minimize negative watershed impacts on water quality



- Improved water efficiency increases water level in surface waters
- Use produced water for CHP and other thermo plants would enable more water in rivers
- Mercury from coal plants biggest contribution to mercury in surface water
- Need to understand how urbanized water sheds are impacted
- Need better tools to assess net impact of energy on environment
- Climate variability is impacting reservoir yields
  - Could cause habitat degradation
  - Habitat degradation due to energy production
  - Impacts to air quality from mineral and energy development
  - Nuclear waste repository impacts on ecological use

### **Economic Development**

#### Water Pricing

- Water pricing needs to be able to better match true cost of water
  - Look at federal policies toward pricing and subsidies
  - Include economic analyses on how to structure subsidies
  - Consider price induced technical change
- Need to know how to handle externalities
  - Ecological, environmental, societal needs
    - Need better science base to address what this really is and impacts
- Tiered structure for pricing
  - Would give more credit for conservation – which is not done well now

### **Other**

- Fast track Water and Energy Research through Coordination
  - DOE should coordinate efforts with local and state governments to coordinate energy and water
  - Need better outreach of capabilities

Flood control agencies need to be better involved in water issues and use

Issues of tariffs on energy imports

Include national security interests in overall aspects

- Share protection costs of critical infrastructure

EWN Needs Assessment Workshop  
West Workshop - Sessions 3 and 4  
Group A

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**Group A – Session 3 - Needs**

Problem: Reliability of reclaimed water for industries, refineries, power generation

Needs: Produced water

- Explore potential uses across country
- Bring all groups together to assess how to allocate and use this water (state by state issue as well as transboundary issue)
- Develop best practices document for treatment, use, and education of public of benefits
- Technologies to handle and dispose of concentrate and residuals
  - Use brine for beneficial use
  - Better treatment for coals fines, metal membranes, to improve treatment for discharge, and technology transfer
  - Need funding for demos, tech transfer to reduce risks
- Modeling to show impacts of disposed concentrate
  - Including re-injection aquifer availability
- Understand TDS impacts and materials to handle
- Better science-based policies on produced water use
  - Better understanding of produced water soil/quality interactions
  - Has applications for irrigation, rangeland applications
  - Include other regulatory groups
- Need roadmap for each state or user's guide on how reclaimed water can be used, how it will be counted, etc.

Needs: Municipal reclaimed water

- Develop best practices document for treatment, use, and education of public of benefits
- Technologies to handle and dispose of concentrate
- Understand TDS impacts and materials

- Better science-based policies on reclaimed water use and health impacts, especially for aquifer storage and recovery
  - Energy issues, health issues
- Need roadmap for each state or users guide on how reclaimed water can be used, how it will be counted, etc.
- Put in purple pipe in all new developments
- Encourage direct use of gray water – needs science to assess health issues, and identify technologies to allow this to be used
  - Grow biomass for energy
  - Incentives to builders like Arizona to plumb for waste-water use
  - Need to change building codes
- DOE use national labs to work with other agencies and coordinate applications

Need: Co-locate water treatment plants with power generation

- Enables the power plants to use the water as an emergency supply
- Does not require and emergency supply of fresh water and allows fresh water to be allocated and used for other purposes

Problem: Lack of information to address expectations and application of renewables

Need: Conduct studies of impacts, benefits, and costs of high penetration of renewables

- Impacts of intermittencies
- Identify contingencies, modeling, storage, etc., to address problems
- Studies to identify practical application of renewables
- Studies of real applications of sector – where renewables will satisfy water and electrical needs of each sector – i.e. water transmission, agriculture, etc.

Need: Massive improvement of R&D to renewables

- Improve efficiency to 30 %, lower cost
- Improve cost intensity, cost per unit power, transformational technologies
- Solar water heating and better applications to housing

Need: Evaluate a national loading order

- Give it a numerical value on priority as well as a percentage

Need: Tidal Power – Ocean power

- Some areas might need to be revisited – wind generated waves

Need: Education and demonstration outreach of renewables

- Follow EPA ETV program approach for evaluation, testing etc.

Need: Run of flow hydro

- More study and design of micro turbines for low head power
- Permitting process is causing a problem with FERC
- Consider how to replace reduced hydro with other base load

Need: Better integration of intermittent renewables

- Energy storage research
- Research on tying renewables to grid
- System design of hybrids

Need: National energy conservation policy

Problem: Transmission constraints for using less water efficient technologies

Need Transmission for remote renewables

- Permitting issues a problem
- Wind big in remote areas – is a national resource?
- Change national power transmission organization
- Incentives or tariffs for investment
- Reduce losses in transmission – tradeoff of different approaches i.e DC line, high KV AC lines
- Oil and gas pipelines need to be considered also
  - Primarily political issue

Problem: Lack of data on availability of GW for electric power generation

Need: Better understanding of GW resources

- Better info on water quality, quantity,
- Better modeling of surface water and gw interactions and yields
  - Better understand yield, reduce uncertainties in identifying yields
  - Requires better monitoring and data – real-time data
  - Add better geochemical information

Need: DOE, DOI, industry, universities need to better cooperate on water issues with states

- National consortium for improving gw modeling
  - Use oil and gas info approaches
  - Use supercomputers from labs
  - Develop easier methods to use models
  - Data base exists that could be mine for info on brackish and fresh water
  - Reservoir engineering
- Coordinate efforts with interagency task force on water data analysis

Need: Develop approach to appropriate data base management and use

- Identify isotopic techniques that can help identify quality
- Develop consistent data base that can be used for this and can talk to each other

Problem: Need streamlining, lack of consistency, lack of good science to drive permitting

Need: Permitting to encourage competition between energy providers

- Rail, versus pipelines, vs. transmission lines

Need: Develop offices for permit assistance

- Address issues with different energy type permits
- Address issues of different water type permits

Need: Develop a model compact for energy development

- Follow Utton Center model approach to transboundary water compacts
  - Consolidate overlapping of permitting
  - Follow DOI – Enterprise Architecture Process, Framework on Water Management

Need: Better federal direction on ranking of priorities for water and energy

- Develop a standard weighting matrix and process
- Include externalities and metrics– value of energy, impacts of energy on water, environmental, risks, etc.
- Develop basin plans – based on system analysis

Problem: Hydro issues- spill vs. power, trust and licensing

Needs: Better understanding of efficacy of spills

- More research on science-based information
  - Improvements to reduce fish mortality
  - Assess factors impact aquatic environment and look at different approaches – assess limiting factors
  - Modeling impacts of loss of hydro in future on environment, CO2, global climate change, other water loss
  - Use information to drive actions
  - To do this requires a systems dynamic model for decision support
- Need more demonstration, deployment efforts to evaluate risks
  - Better understanding, better outreach of information to show benefits

Problem: Matching water price with water value

Need: Analysis of water and energy impacts of reduced water and crop subsidies

- Needs to include impacts on food supply, environment, national security, societal changes, economy
- Will require system level decision support tool

Need: Analyze how water marketing and energy pricing structures impact energy and water efficiency

Need: Better understanding of water markets

Need: Better understanding of externalities – in-stream flow, benefits of irrigation, environmental impacts, and

Need: Need to quantify all water rights – identify consumptive use limits

- Quantify losses - infiltration, evaporation-transpiration, conveyance losses

Need: Identify worth of conservation

Need: Water pricing to escalate

Problem: Food production

Need: Understand water change impacts on food production and security

Problem: Equivalent program to Energy Star to drive energy and water conservation

Need: A national water efficiency program

- Use incentives for water conservation
  - Make efficiency minimum a requirement for revolving funds
- Include education and outreach
- Regional and local recognition
  - Incentives to encourage municipal and utilities to participate
  - Rewards for good waste water quality
- Technology research to improve water and energy conservation technologies
- Allow water saved to be sold as a commodity

Need: Mechanism for utilities that save water to get a credit for energy savings

- Include conveyance, etc. in the credit

Need: Technologies for smart control of water

- Important for domestic landscape for easy programmable control
- Better monitoring of hydrologic events so do not send irrigation water at wrong time and water lost or used inappropriately
  - Load forecasting for irrigation loads

Need: Determine candidate technologies for hot water handling and use

- Standards for design and Utilization

Problem: Lack of national coordination of energy and water interrelations issues

Need: Better communication of policies

Need: Coordination of energy and water planning

- Lack of fast tracking of energy and water permitting
- Planning at regional or state levels

Need: Insure limitation of federal barriers to use of new technologies

Need: Site power plants near desal and water reuse plants

Problem: lack of understanding of in-stream flows needs

Need: Define, provide, and protect in-stream flows

- Provide science-based information to identify and define flows needed
  - Monitoring ecological impacts
  - Right flows for life stages, timing, water temperature,
- Funding mechanism to acquire in-stream flows

Need: Identify needs and manage water for species of interest by basin ASAP

Problem: Climate change and climate variability

Need: Need to analyze regional climate change probabilities and implement into regional planning

- Include uncertainties in planning
- Better management of flood plains
- Better understand aquifer storage, quality, how much can you get back,

Need: Reduce uncertainty of climate change through better modeling

Need: Better understand watershed changes and impacts on water

Need: Take information on climate models and disseminate to regions and identify projections of water availability

Need: Utilize concepts of contingent water rights

Need: Quantify reduction of green house gases by use of energy and water efficiency technologies

- Plan for variability
- Encourage regional CO2 trading to reduce green house gases

#### **Session 4 - Solutions:**